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## SPECIFICATION AMENDMENTS

*Page 1, Lines 2-5*

This patent application is a continuation of United States Patent Application Serial No. 10/410,492, filed April 9, 2003, which claims benefit from U.S. provisional patent application Serial No.'s 60/372,008, filed April 10, 2002; 60/371,967, filed April 10, 2002; and 60/445,866, filed February 6, 2003, the contents of all of which are incorporated in their entirety herein by reference.

*Page 8, line 16 to Page 9, line 5:*

Two important lessons were learned from the TRITON Program, both in (i) the development of bellows to provide a low-loss, reliable, dynamic pressure flexure seal, and in (ii) the appreciation of the non-linear hydrodynamic losses associated with oscillatory gas flows at high Reynolds number and at transitions between parts of the resonator with different cross-sectional areas that is known as "minor loss" or "head loss." It was recognized by the inventors that the resonator losses could be entirely eliminated and the size of a thermoacoustic chiller, for a given cooling capacity, could be substantial reduced, if the thermoacoustic core (regenerator and heat exchangers) and phasing network (inertance and compliance) were contained entirely within the bellows. Furthermore, it was recognized by the inventors that the resonant enhancement of the pressure oscillations created by the double-Helmholtz resonator could be duplicated, without the non-linear hydrodynamic losses inherent in the high-velocity gas motion through the neck, by using the elastic stiffness of the gas contained with the bellows and the moving mass of the linear motor and its attached piston, to create a mechanical resonator rather than a purely acoustic resonator used in TRITON, as well as all of the earlier thermoacoustic refrigerators. This novel resonator was named a "Bellows Bounce" compressor by its inventors, and is the subject of U.S. provisional patent application Serial No. 60/372,008, filed April 10, 2002, and a co-pending U.S. patent application entitled "Compliant Enclosure for Thermoacoustic Devices," Serial No. 10/409,855, filed April 9, 2003, the entire contents of both of which are incorporated herein by reference.

*Page 9, lines 6-13:*

An alternative to conventional bellows was also developed, and is the subject of U.S. provisional patent application Serial No. 60/371,967, filed April 10, 2002, and a co-pending U.S. patent

application entitled "Cylindrical Spring with Integral Dynamic Gas Seal," Serial No. 10/409,760 filed April 9, 2003, the entire contents of both of which are incorporated herein by reference. The cylindrical spring with integral dynamic gas seal provides an alternative to a more typical bellows that may enable greater design flexibility, lower production cost, and a significantly smaller surface area compared to a conventional bellows of equal volume with similar height and diameter.

*Page 9, line 23 to Page 10, line 20:*

In one embodiment of the present invention, the thermocoustic device includes a housing with a thermal core supported in the housing and having a first and a second surface. The thermal core includes a first heat exchanger defining the first surface of the thermal core and a second heat exchanger defining the second surface of the thermal core. Between these two heat exchangers is a regenerator or other porous thermal storage medium. A main chamber is in fluid communication with the first surface of the thermal core and a secondary multiplier chamber is in fluid communication with the second surface of the thermal core. A working volume of a gaseous working fluid fills the main chamber, the multiplier chamber, and the thermal core at a pressure. An equilibrium pressure is defined as the pressure of the working volume of gaseous working fluids ~~with~~ when the thermoacoustic device is in a non-operating mode. The main chamber includes a first oscillating member that is operable when the thermoacoustic device is in an operating mode to oscillate such that the pressure in the ~~multiplier~~ main chamber is sinusoidally oscillated between a peak pressure greater than the equilibrium pressure and a minimum pressure less than the equilibrium pressure. A main pressure amplitude is defined as one-half of the difference between the peak pressure and the minimum pressure in the main chamber. The secondary multiplier chamber includes a second oscillating member that is operable when the thermoacoustic device is in the operating mode to oscillate such that the pressure in the multiplier chamber is sinusoidally oscillated between a peak pressure greater than the equilibrium pressure and a minimum pressure less than the equilibrium pressure. A multiplier pressure amplitude is defined as one-half of the difference between the peak pressure and the minimum pressure in the multiplier chamber. The first and second oscillating members oscillate at substantially the same frequency and such that the pressure oscillations in the main chamber and the multiplier chamber are substantially in phase with each other. The multiplier pressure amplitude is greater than the main pressure amplitude.

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*Page 10, line 21 to Page 11, line 10:*

In another embodiment, a thermoacoustic device includes a housing with a first end and a second end. A cold head heat exchanger defines the first end of the housing. The cold head heat exchanger has an exterior heat exchange surface in thermal communication with an interior heat exchange surface. A multiplier chamber is disposed in the housing and has a multiplier volume defined therein. The multiplier volume includes a multiplier oscillating member which is movable such that the multiplier volume is increased and decreased. A main chamber is disposed in the housing and has a main volume defined therein. The main chamber includes a main oscillating member which is movable such that the main volume is increased and decreased. A support is disposed in the housing adjacent the interior heat exchange surface of the cold head heat exchanger. The support defines a first passage between the multiplier volume and the interior heat ~~exchanged~~ exchange surface of the cold head heat exchanger and a second passage between the main volume and the interior heat exchange surface of the cold head heat exchanger. Therefore, the main volume and the multiplier volume are in fluid communication through the first and second passages. A thermal storage element is disposed in one of the passages. The thermal storage element has a first surface and a second surface, with the first surface being adjacent the interior heat exchange surface of the cold head heat exchanger. A hot heat exchanger is disposed [[and]] adjacent the second surface of the thermal storage element. In some versions, the multiplier chamber is disposed inside the main chamber.

*Page 20, lines 8-12:*

Instead of rigid connection of motor 126 to base plate 124, a resilient motor mount could be substituted to produce a two-degree-of-freedom system. Motor 126 can thus move with a phase that is opposite to motor moving part. Such an arrangement could reduce transmission of vibration to other parts of the structure containing the thermoacoustic engine or refrigerator.

*Page 21, lines 5-12:*

The embodiment of the present invention shown in Figure 4 utilizes a "compliant enclosure," as discussed more fully in U.S. provisional patent application Serial No. 60/372,008, and the co-pending patent application entitled "Compliant Enclosure for Thermoacoustic Devices," Serial No. 10/409,855 filed April 9, 2003. The compliant enclosure is defined primarily by the bellows 132, which provide the

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sidewalls of the enclosure. The cold head heat exchanger 112 and support or platform 118 cooperate to define the upper end of the compliant enclosure, while the piston 128 closes off the lower end of the compliant enclosure.

*Page 21, line 25 to Page 22, line 9:*

A working volume for the device 110 may be defined as the volume of a working gaseous fluid contained in the compliant enclosure. In the illustrated embodiment, the working volume is preferably smaller than the bellows volume, since much of the bellows or flexure volume is displaced by other items. The working volume may be defined as the bellows or flexure volume minus any volume displaced by components that extend into the bellows or flexure volume, plus any additional volume outside of the bellows. For example, additional volume is provided inside the regenerator 114, the fins 142, and the passages 146. It should be noted that the multiplier volume 134 is not considered displaced from the volume, since it also contains a portion of the working volume of the device 110. Alternatively, the working volume is also equal to the main volume 144, plus the multiplier volume 134, plus any additional volume contained in the passages 146, fins 142, and regenerator 114. As the hot heat exchanger 116 extends partially into the multiplier volume 134, the volume contained therein may be considered to be part of the multiplier volume. Alternatively, it may be considered part of the additional volume.

*Page 22, line10 to Page 23, line 7:*

In accordance with the discussion in the incorporated disclosures, the compliant enclosure design allows for significantly larger volume changes, and therefore significantly higher pressure fluctuations in the main volume 144 and multiplier volume 134. Preferably, the working volume is less than or equal to the bellows volume, though in some embodiments, the working volume may be greater than the bellows volume. For example, the working volume may be less than or equal to 1.0 or 5.0 times the bellows volume. In other embodiments, the working volume is equal to or less than .9 times the bellows volume, or .85 times the bellows volume. In accordance with incorporated disclosures, it is preferred that the pressure amplitude (defined as half the difference between the peak pressure and minimum pressure) is at least five percent of the equilibrium pressure. The equilibrium pressure is defined as the pressure within the device when it is in its non-operating mode. As discussed

hereinbelow, known flexure seals are generally limited to a displacement of no more than ten percent of their length for an application such as in the present invention. With a gas with a polytropic coefficient of 5/3, this allows a pressure amplitude of almost 17 percent if the working volume is approximately equal to the bellows volume. According to the present invention, it is preferred that the pressure amplitudes be at least five percent. Therefore, the working volume may be as much as 3.4 times the bellows volume. By utilizing improved flexure seals such as disclosed in two of the incorporated disclosures, or by optimizing a flexure seal design using the approach in U.S. provisional patent application Serial No. 60/445,866, it is envisioned that flexure seal displacements may be able to be increased to as much as 15 percent of their overall length. This allows the working volume to be increased to as much as 5.1 times the bellows volume while still providing a pressure amplitude of five percent. In light of the above, the present invention provides a device wherein the working volume is less than or equal to five times the bellows volume. It is more preferred that the working volume be less than or equal to four times the bellows volume. Three times bellows volume or two times bellows volume is even more preferred.

*Page 23, lines 19 – 29:*

The device 110 is illustrated with a traditional corrugated-side cylindrical bellows 132. In one preferred embodiment, the bellows is [[a]] thin metal with convoluted sides. Alternatively, a cylindrical spring with an integral dynamic seal may be used. A design for a cylindrical spring with an integral dynamic gas seal is disclosed in U.S. provisional patent application Serial No. 60/371,967, and in a co-pending U.S. patent application Serial No. 10/409,760 filed April 9, 2003, entitled "Cylindrical Spring with Integral Dynamic Gas Seal," the entire contents of both of which are incorporated herein in their entirety by reference. For a metal spring sealed with a low-loss elastomer (such as a cylindrical spring with an integral dynamic gas seal as provided by the incorporated disclosures), the surface area of the cylindrical spring may be three to four times less than a conventional formed metal bellows resulting in a similar reduction in the resonator surface loss shown in Figure 9.

*Page 39, line 16 to Page 40, line 8:*

The thermoacoustic devices described thus far have all made use of compliant enclosures in accordance with U.S. patent application Serial No. 60/372,008 and the co-pending patent application

Serial No. 10/409,855 entitled "Compliant Enclosure for Thermoacoustic Devices." However, the present invention is not limited to the use of compliant enclosures. Instead, a clearance seal approach may be used. Figure 13 illustrates a thermoacoustic device 220. The device 220 includes a pressure vessel 222 with a linear motor 224 mounted at one end. The motor is interconnected with a piston 226 which is closely fitted into the interior diameter of the sidewalls of the pressure vessel 222. A radial seal 228 is provided between the sides of the piston 226 and the walls of the pressure vessel 222. As known to those of skill in the art, the radial seal may include a clearance seal, a dynamic O-ring, or other approaches. A main volume 230 is defined inside the walls of the pressure vessel 222 and above the piston 226. A multiplier volume 232 is defined inside of a multiplier chamber 234 and above a multiplier member or piston 236. While the multiplier piston 236 is shown as being sealed to the remainder of the multiplier chamber 234 using a flexible edge seal, it may alternatively also use a radial seal, such as a clearance seal, a dynamical ring, or other approaches. Alternatively, the multiplier chamber 234 may have a flexure seal forming part or all of its sidewall, such as shown in Figure 14. As will be clear to those of skill in the art, a designer of a thermoacoustic device may choose to "mix and match" flexure seals, edge seals, radial seals, and any other approaches to oscillating the volume and pressure of the main chamber and multiplier chamber in any of the various embodiments herein. The device 220 operates in a manner similar to the embodiment of Figure 4 with respect to the heat exchanger and regenerator designs.